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Indian Standard
SPECIFICATION FOR ARE COMBS

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SPECIFICATION FOR ARE COMBS

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(*Continued on page* 11)

Indian Standard
SPECIFICATION FOR ARE COMBS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 15 March 1977, after the draft finalized by the Optical and Mathematical Instruments Sectional Committee had been approved by the Mechanical Engineering Division Council.

0.2 This standard is intended to cover the are combs for determination of areas from maps and plans. Are comb commonly used in cadastral surveys may vary in design. The most common design of are comb is covered in this standard. Since are combs are used in fps system the nomenclature has been changed to are combs in metric system.

1. SCOPE

1.1 This standard lays down the dimensions and general requirements of are combs.

2. PRINCIPLE

2.1 The principle is to erect false offset ordinates at regular intervals in the figure, the area of which is to be calculated. The figure is then considered as divided into trapezoidal or rectangular strips of constant width. The area is then expressed by the product of the length of mid-ordinate and the width (*see* Fig. 1). Then area (A) of strips $= d\Sigma m$, where Σm is the sum of the ordinates m_1, m_2 and m_3, etc, measured on the scale given on the comb (Fig. 2) and d is the common width between the offset ordinates or parallel lines. The width d between parallel lines is some integral number of millimetres depending on the scale of map or plan and is chosen such that the area in ares may be found directly for any given scale. Thus, the total length of mid-ordinates will directly represent the area of the figure.

3. CONSTRUCTION AND MATERIAL

3.1 The are comb shall consist of a rectangular plastic sheet from which a central rectangle has been cut out and threads stretched at equal intervals through holes perforated through the plastic sheet as shown in Fig. 2. The linear scales in ares or hectares as shown in Fig. 2 shall be drawn on plastic sheet. The threads shall be located in grooves on the plastic surface or on the undercut surface so that they are not subjected to rubbing when are comb slides on the map.

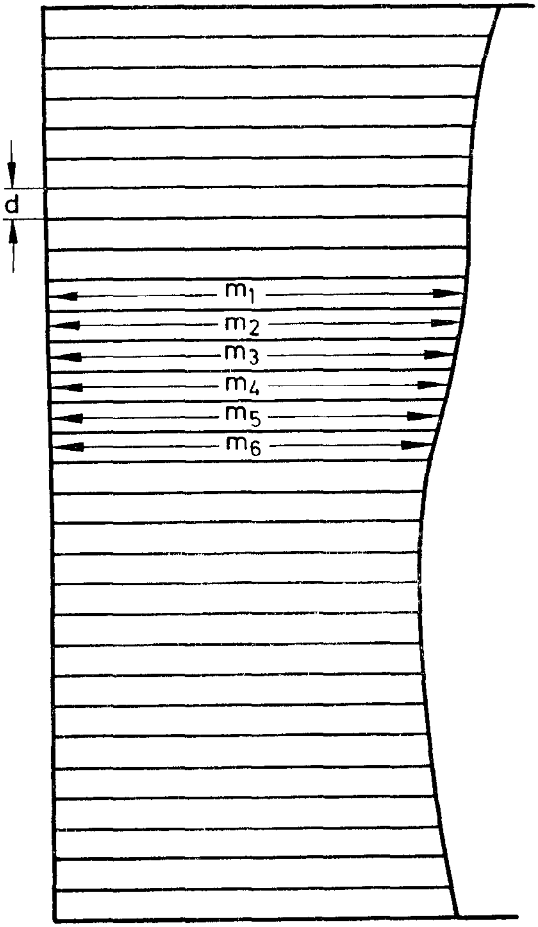
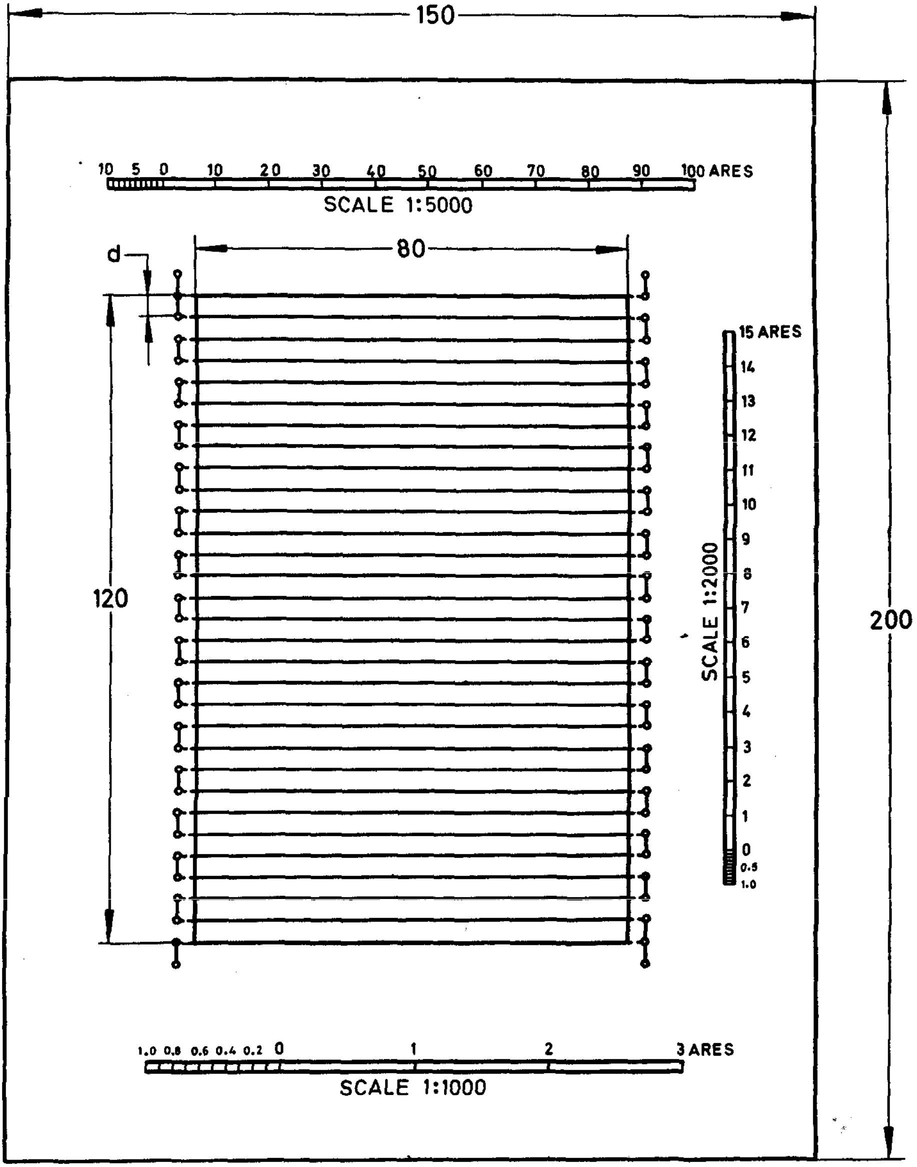


FIG. 1

3.2 The rectangular flat sheet shall be of transparent or opaque plastic. The recommended plastic materials are acrylic and rigid polyvinyl chloride. The plastic sheets shall be smooth, even on both sides and free from blisters, porosity and other defects.

3.3 The thickness of material shall be 2±0·2 mm.

3.4 The threads used on the combs may be of nylon fibres and shall not become loose. The thickness of threads shall be 0·25+0·05 mm.



All dimensions in millimetres.

FIG. 2

4. DIMENSIONS

4.1 The overall size of the are comb shall 20 × 15 cm.

4.1.1 The size of the centrally cut rectangle (*see* Fig. 2) where the threads are fitted through the holes shall be 12 × 8 cm.

4.2 The size of holes and the width between two consecutive nylon thread lines shall be 0·7 ± 0·1 mm and 4 mm respectively.

5. GRADUATIONS

5.1 All graduations of the scale shall be cut stamped, engraved or printed on the are comb and shall be clear, fine and filled up in the black so as to ensure good legibility without the use of magnifying glass.

5.2 Width of the scales on the are comb shall be 2 mm width graduation marks as shown in Fig. 2.

6. PROCEDURE FOR USE OF ARE COMB

6.1 The plastic sheet is placed over the area to be measured in such a way, that it lies fully between two threads. By progressively stretching a pair of dividers along the midordinates between the threads, terminated by the boundary lines of the area to be measured, the area of the plan can be calculated. The sum total of all ordinates as obtained by stretching the divider is placed on the scale of the area printed on the are comb and the area of plan can be read therefrom in ares or hectares. An illustrative example showing the determination of area by the use of are comb is given in Appendix A.

Note—If the boundories are curved to such an extent that appreciable error is likely to be introduced, then areas may be calculated by any other appropriate method.

7. TOLERANCE

7.1 The tolerance for the engraved scale shall be ±0·1 mm per centimetre length for a temperature and humidity change of 40°C and 100 percent respectively.

8. ACCURACY

8.1 The accuracy of are comb for area determination shall be ±3 ares per 100 ares on any scale of survey.

9. MARKING

9.1 Each are comb shall be marked with manufacturer's name or trade-mark and the year of manufacture.

9.1.1 The are combs may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

10. PACKING

10.1 Are comb shall be suitably packed in an envelope made of good quality thick paper with the scales of the are comb marked on it.

APPENDIX A

(*Clause* 6.1)

DETERMINATION OF AREA WITH THE USE OF ARE COMB

A-1. ILLUSTRATION

A-1.1 Figure 3 illustrates an area $a_1\ b_1\ b_2$.................................... $b_{15}\ a_{15}\ a_{14}$..................$a_3\ a_2\ a_1$. This area can be taken to be equal to the sum of the strips $a_1\ b_1\ b_2\ a_2 + a_2\ b_2\ b_3\ a_3 + a_3\ b_3\ b_4\ a_4 + a_4\ b_4\ b_5\ a_5 +$ ....$+ a_{14}\ b_{14}\ b_{15}\ a_{15}$.

Each of these strips is d cm wide. The area of the topmost strip in square centimetres is

$$d \times \frac{a_1\ b_1 + a_2\ b_2}{2} \text{ or } d \times m_1.$$

The area of the next strip is

$$d \times \frac{a_2\ b_2 + a_3\ b_3}{2} \text{ or } d \times m_2.$$

The area of the next strip is

$$d \times \frac{a_3\ b_3 + a_4\ b_4}{2} \text{ or } d \times m_3 \text{ and so on.}$$

Therefore, the total area of all the 14 strips of which the complete figure is made of is $d \times (m_1 + m_2 +$ .... $+ m_{14})$ cm^2.

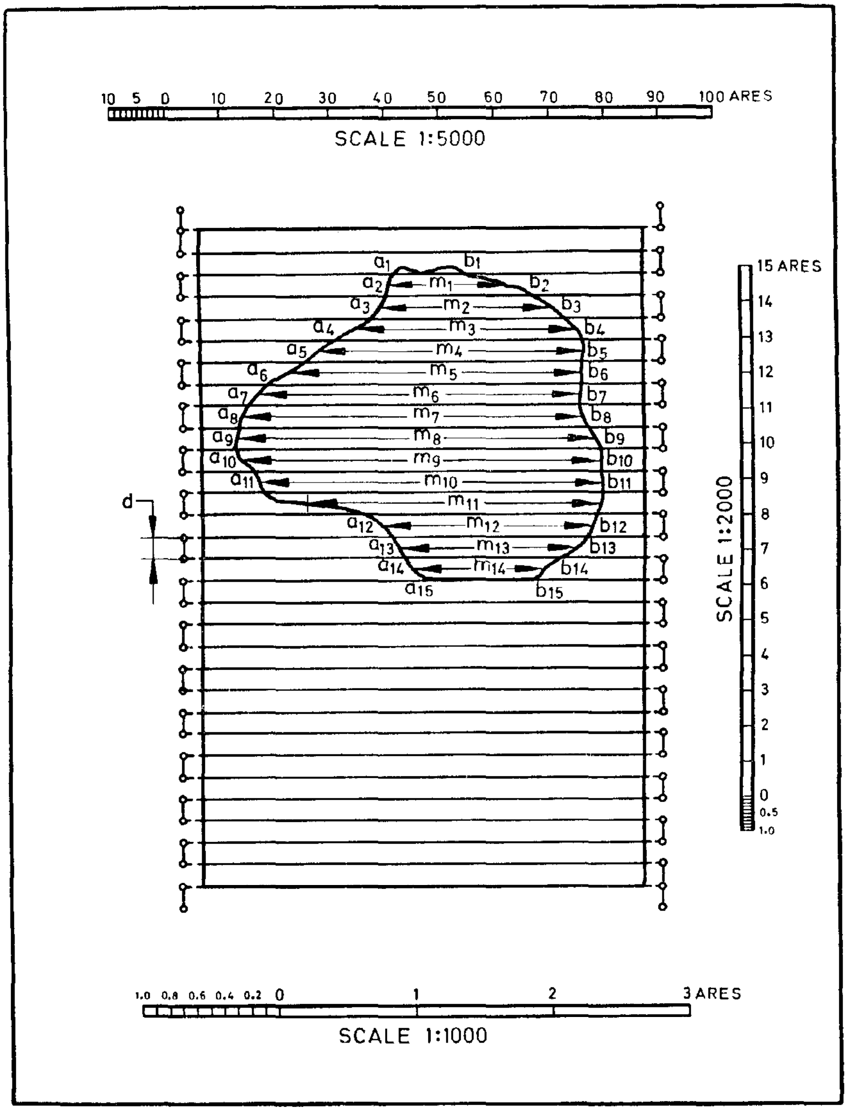

10 5 0 10 20 30 40 50 60 70 80 90 100 ARES
SCALE 1:5000
a1 b1
a2 m1 b2
a3 m2 b3
a4 m3 b4
a5 m4 b5
a6 m5 b6
a7 m6 b7
a8 m7 b8
a9 m8 b9
a10 m9 b10
a11 m10 b11
m11
a12 m12 b12
a13 m13 b13
a14 m14 b14
a15 b15
d
15 ARES
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
0.5
1.0
SCALE 1:2000
1.0 0.8 0.6 0.4 0.2 0 1 2 3 ARES
SCALE 1:1000

FIG. 3

A-1.2 The lengths m_1, m_2, m_3, etc, are measured with the help of a pair of dividers. The pair of dividers may be opened out and put along the length m_1. Then it is lifted and right-hand point of the dividers put on the left end of m_2 so that the left-hand point of the dividers falls along the extension leftwards of m_2. The left-hand point is kept fixed on paper and right-hand point of the dividers extended up to right-hand end of m_2. The total length between the two points of the dividers now becomes m_1+m_2. The measurement proceeds further in this way till the length between the points of the dividers becomes equal to $m_1+m_2+m_3+\dots\dots\dots+m_{14}$.

NOTE — If this total becomes too big, the individual lengths may be measured separately and added.

A-1.3 If the scale of the map denoted by the figure is say, 1:5 000, the *ground* area of the figure in square centimetres becomes $(d \times 5\,000) \times (m_1 + m_2 + \dots\dots + m_{14}) \times 5000$ or $d \times$ (sum of the lengths m_1, m_2, $m_3 \dots\dots$ and m_{14}) $\times (5000)^2$.

Since one are (a) $= 100\ m^2 = 100 \times 100 \times 100\ \text{cm}^2 = (1000)^2\ \text{cm}^2$ the above area becomes

$$(m_1 + m_2 + \dots\dots\dots\dots + m_{14}) \div \left[\frac{(1000)^2}{(5000)^2} \cdot \frac{1}{d}\right].$$

A-1.4 If, therefore, we have a linear scale, the unit of length along which is established to be

$$\frac{(1000)^2}{(5000)^2} \times \frac{1}{d}\ \text{cm},$$

then the paper length $(m_1 + m_2 + \dots\dots\dots\dots + m_{14})$ measured along this scale (and *not* in centimetres) will be

$$(m_1 + m_2 + \dots\dots\dots\dots + m_{14}) \div \left[\frac{(1000)^2}{(5000)^2} \times \frac{1}{d}\right] \textit{units} \text{ and}$$

hence the measured units will be equal to the number of ares in the figure. The sum of the distances $m_1 + m_2 + \dots\dots\dots + m_{14}$ is measured off with a pair of dividers and placed on this scale and read off. The result will give the area of the figure in ares on 1:5 000 scale.

A-1.5 When the scale of the map is 1:1 000, the area of this figure in square centimetres will be $(d \times 1000) \times [\,(m_1 + m_2 + m_3 + \dots\dots + m_{14}) \times 1000\,]$ and this expressed in ares will become:

$$d \times \frac{(1000)^2}{(1000)^2} \times (\text{ sum of all the sides }).$$

The result in ares may read directly from the scale constructed with a unit length as $\frac{1}{d}$ cm.

A-1.6 In general, if the scale of the map is 1:X the area in ares will be

$$d \times (\text{sum of the sides}) \times \frac{X^2}{(1\,000)^2}$$

and if a linear scale is constructed with a unit length along it as

$$\frac{(1\,000)^2}{X^2} \times \frac{1}{d} \text{ cm},$$

then the length $m_1 + m_2 + m_3 \ldots\ldots\ldots\ldots + m_{14}$ measured along this scale will represent the area in ares of the figure on scale 1:X.

(*Continued from page* 2)

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1492-1959	Metric surveying chains
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1779-1961	4-Metre, levelling staff, folding type
1842-1961	Surveying chain pins (arrows)
1955-1961	Prismatic compass liquid
1957-1961	Prismatic compasses, non-liquid
2288-1963	Ranging rods
2539-1963	Plane tables
2976-1964	Optical theodolite
2988-1965	Vernier theodolite
4380-1967	Abney level
4590-1967	Engineer's level
5146-1969	Sounding sextant
5706-1970	Spirit levels for use in precision engineering
5928-1970	Tangent clinometer
7009-1973	Optical square (for surveying)